FloodSAFE CALIFORNIA

BWFS/CS Technical Workshop #2

Technical Session B1:
Hydrologic and Hydraulic Modeling Tools Overview

October 23, 2013

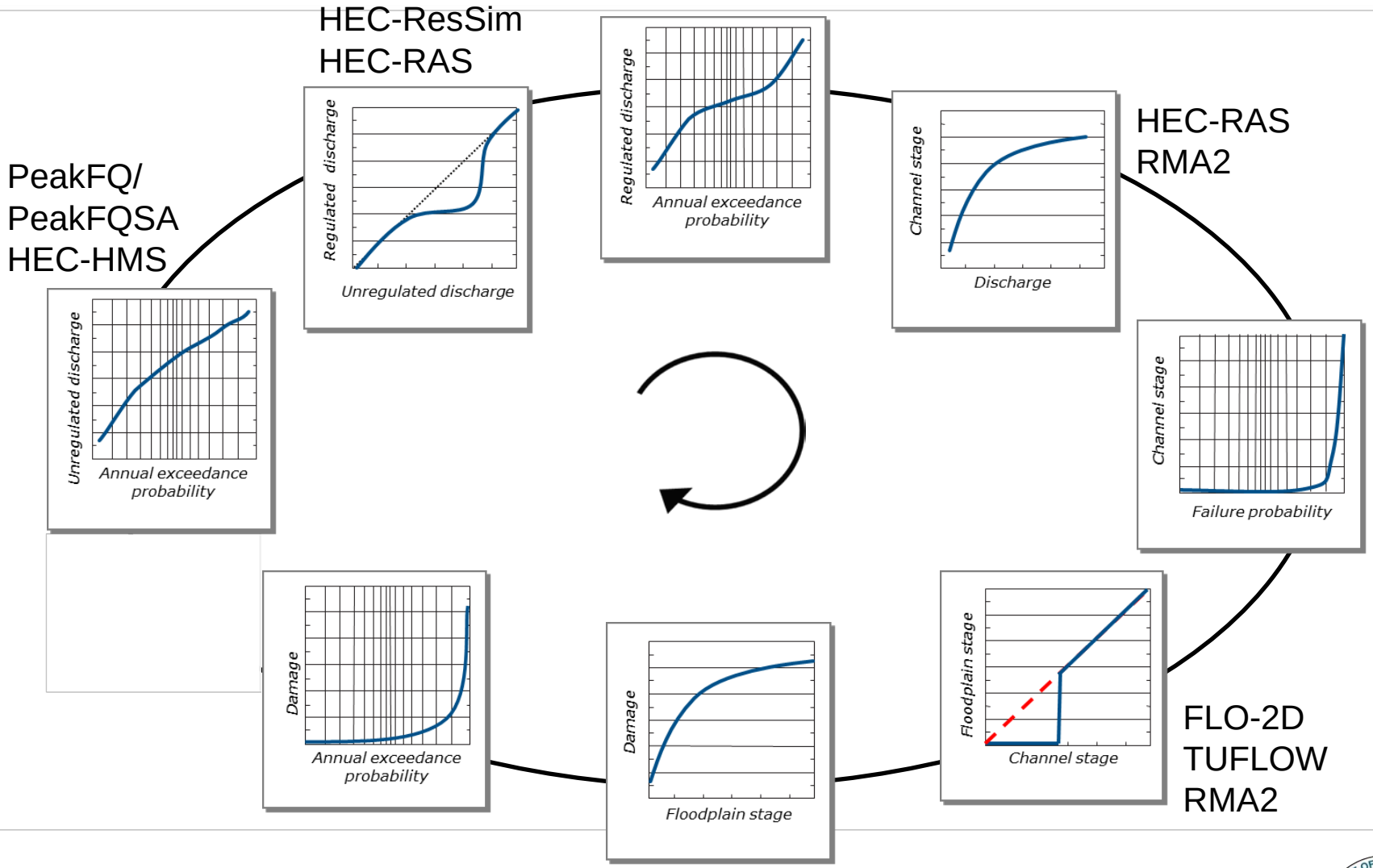
Objectives to be evaluated by H&H tools

Objective Topic
1. People and Property at Risk 1a. Urban Flood Protection 1b. Small Community Flood Risk Reduction 1c. Rural-agricultural Area Flood Risk Reduction
2. Flood System Flexibility
3. Flood System Resiliency
4. Wise Floodplain Management
5. Ecosystem Processes 5a. Inundated Floodplain
15. Integrated Water Management

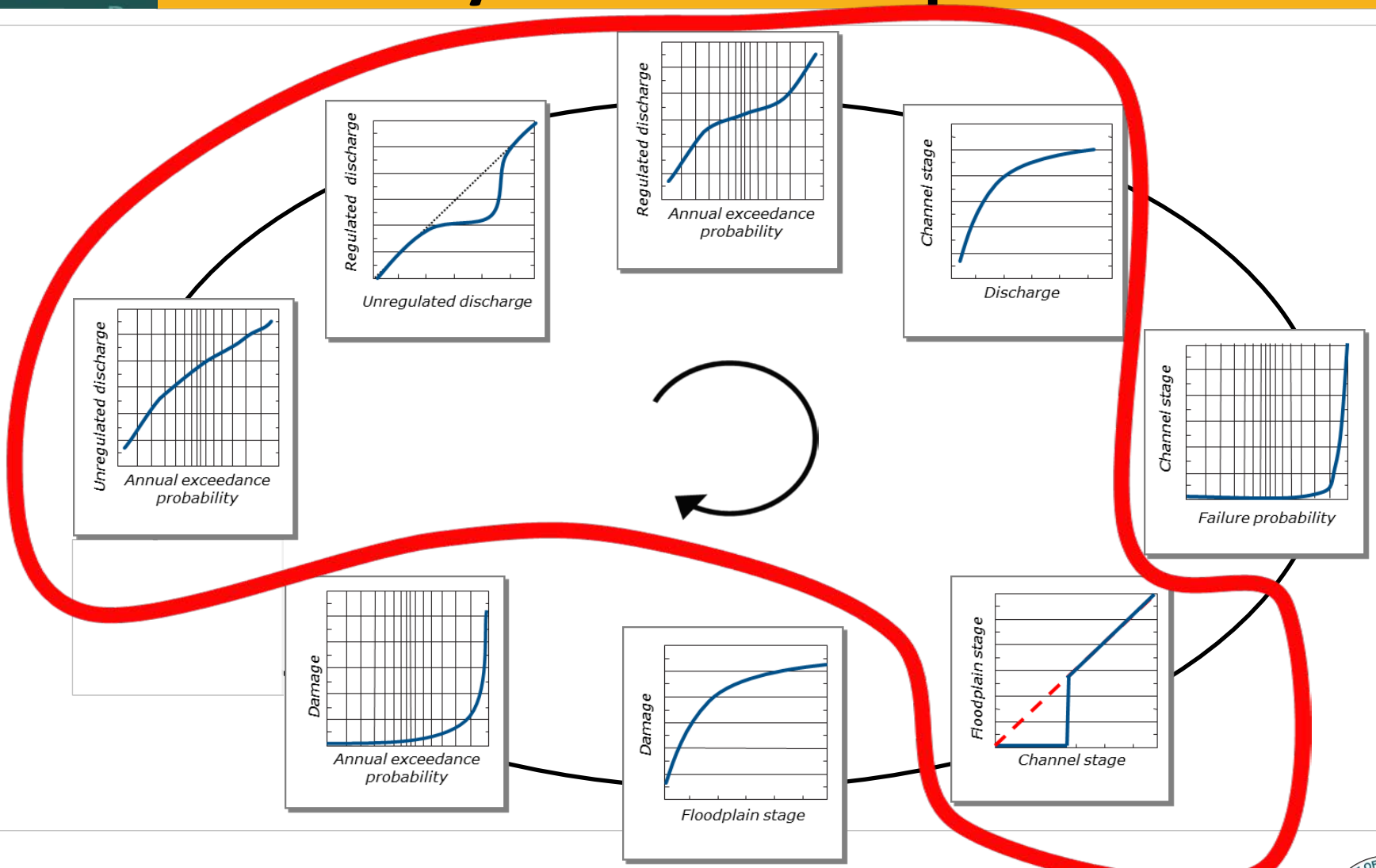
H&H Tools Used for Defining the Flood Hazard

- The floodplain stage frequency curves are a function of:
  - Unregulated flow-frequency curves
  - Unregulated- regulated flows
  - Discharge- channel stage relationships
  - Channel- floodplain stage relationships
- Hydrologic and hydraulic tools are modified to reflect refined system configurations, evaluate changes to the floodplain stage frequency curves

Risk Analysis



Risk Analysis: H&H Components



Sacramento-San Joaquin Watershed

Sacramento River

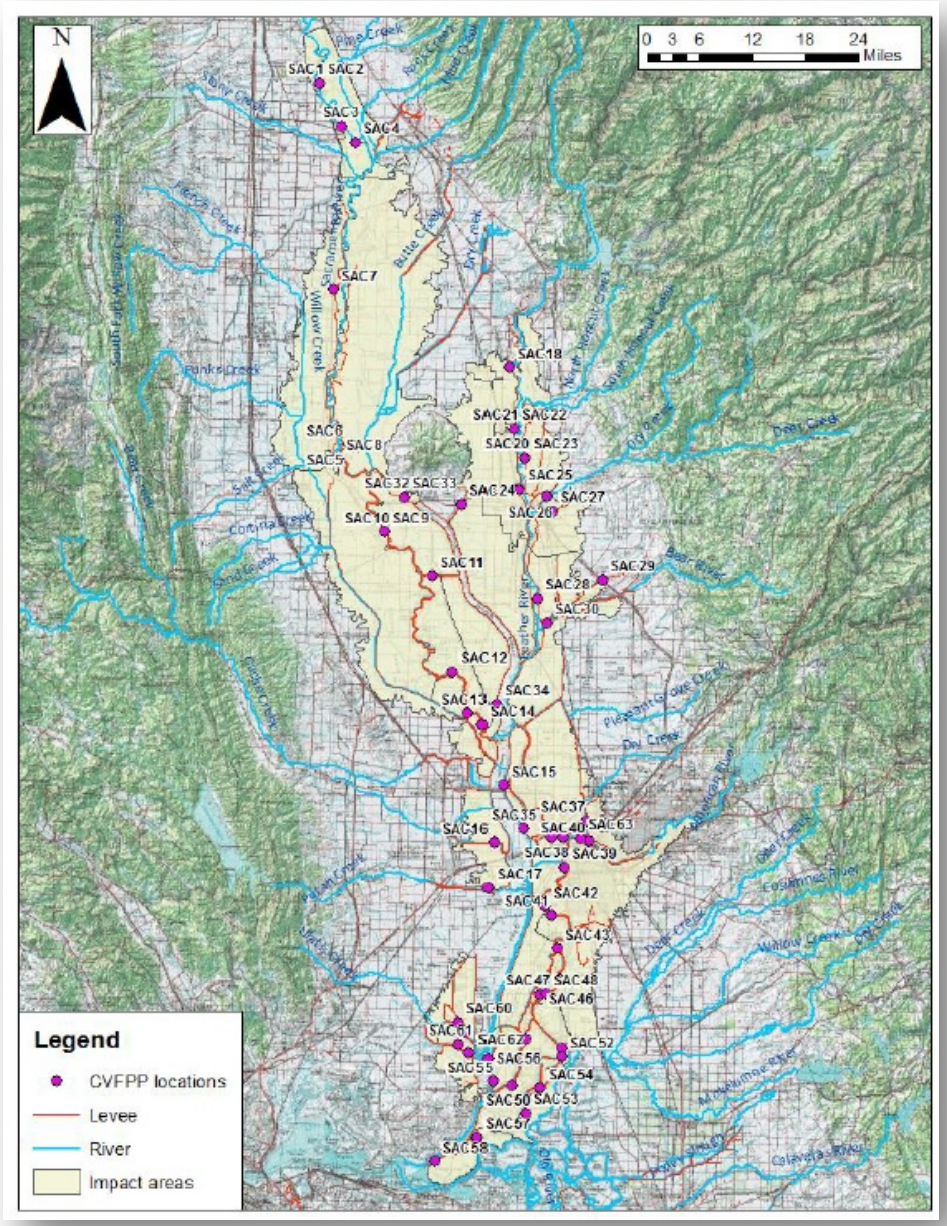
- At Rio Vista = 27,000 sq mi.
- 37 reservoirs

San Joaquin River

- At Mokelumne River = 20,000 sq mi.
- 36 reservoirs

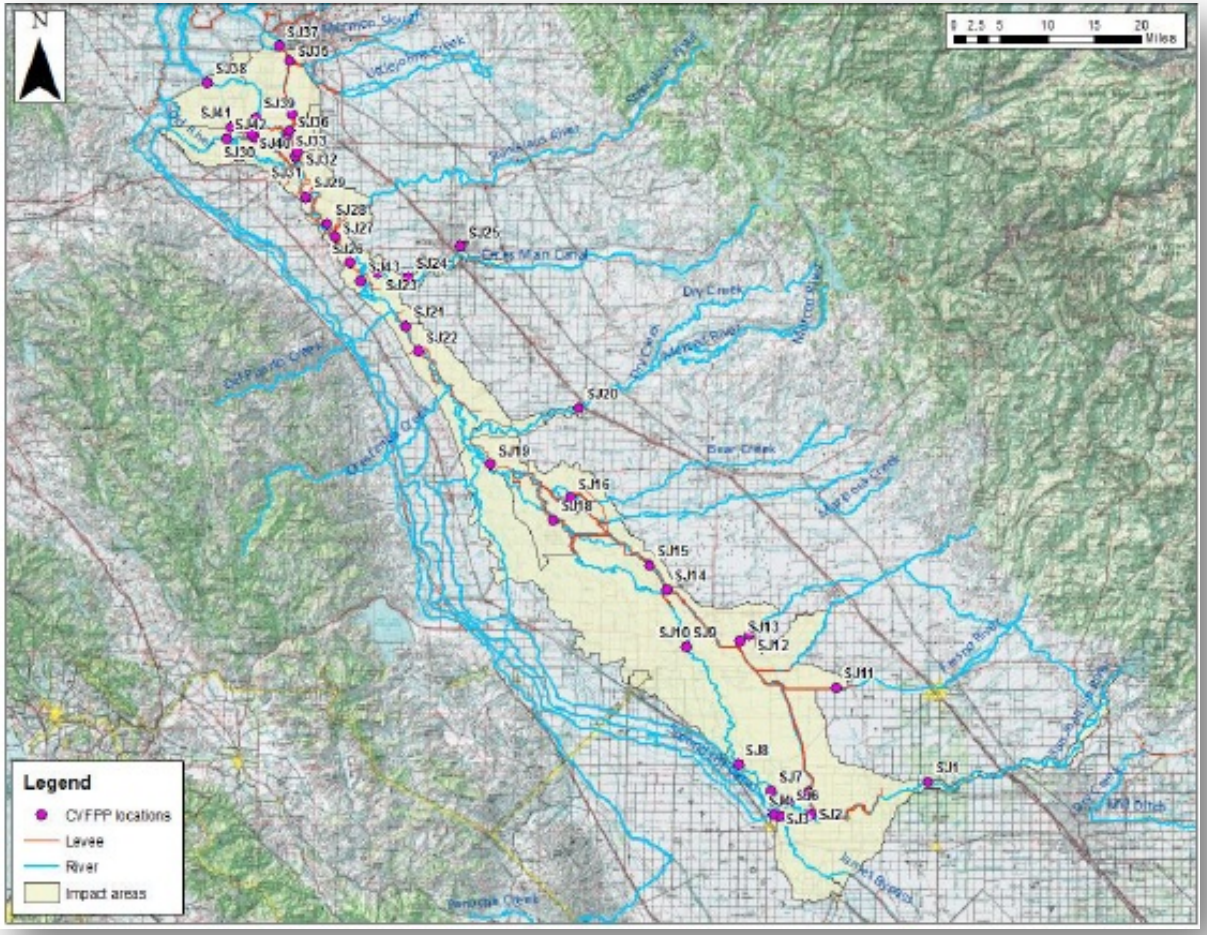
Study Area for System Risk Analysis

- Sacramento River Basin
  - ✓ 61 impact areas and index points



Study Area for System Risk Analysis

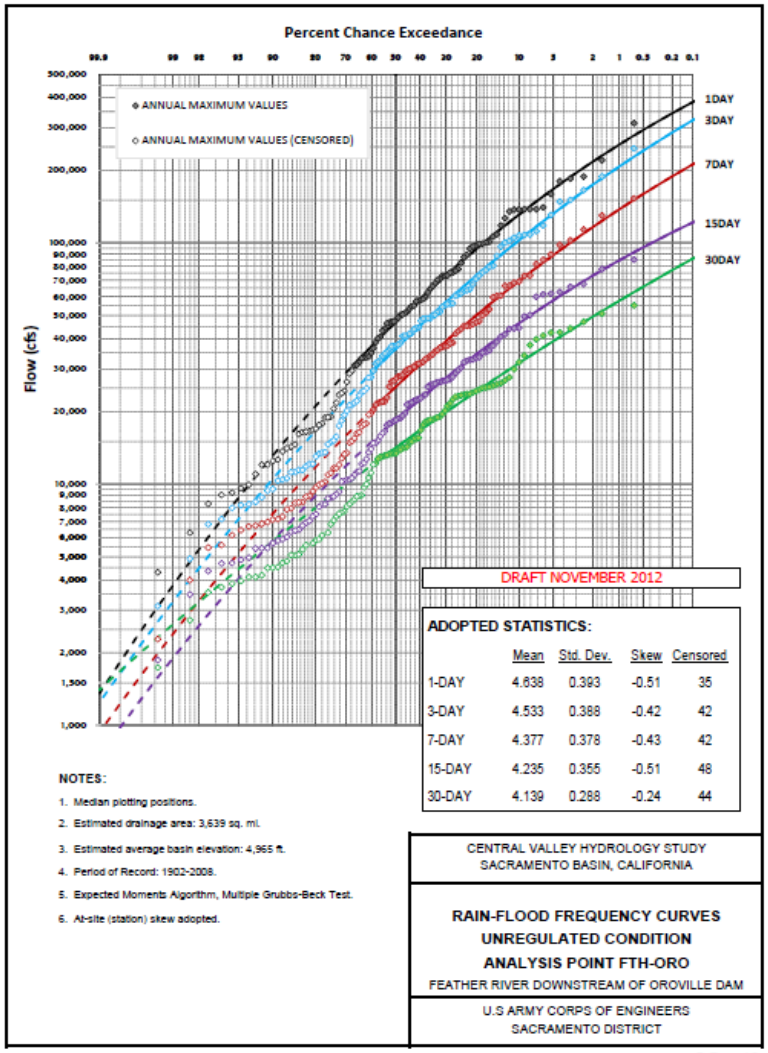
- San Joaquin River Basin
  - ✓ 43 impact areas



Modeling Tools and Applications

1) Unregulated flow frequency curves throughout Sac and SJ system, using **Peak FQ/Peak FQSA**
2) For "ungaged" watersheds, rainfall-runoff simulation models, using **HEC-HMS**
3) Sac and SJ reservoir simulation model, using **HEC-ResSim**
4) Sac and SJ channel model, using **HEC-RAS**
5) Sac and SJ floodplain model, **FLO-2D** and **TUFLOW**
6) Sac and SJ Delta model and bypass model, using **RMA2**

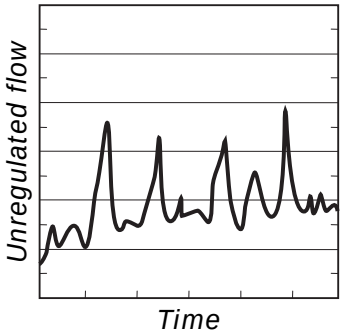
1) Peak FQ/Peak FQSA: Volume (Unregulated Flow) Frequency



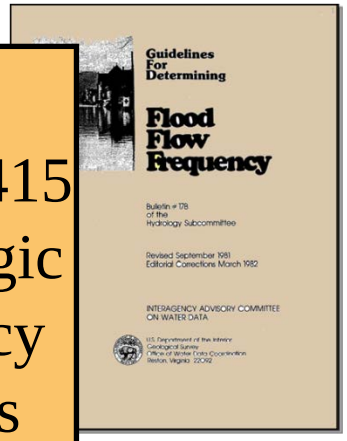
- Represents maximum potential flow to the analysis point.
- “Unregulated time series” not necessarily the same as “full natural flow” or “natural flow.”

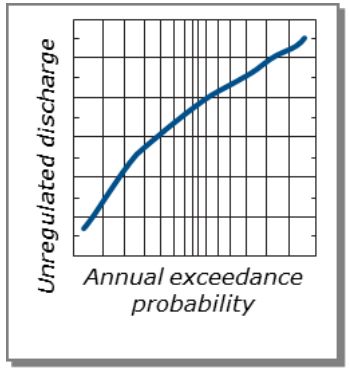
1) Peak FQ/Peak FQSA: Basic Analysis Steps Followed

1. Construct unregulated series (or get measured flows).
2. Extract annual maximums.
3. Inspect series.
4. Fit statistical distribution.
5. Review fit.
6. Review for *regional* consistency.
7. Adopt frequency curve.



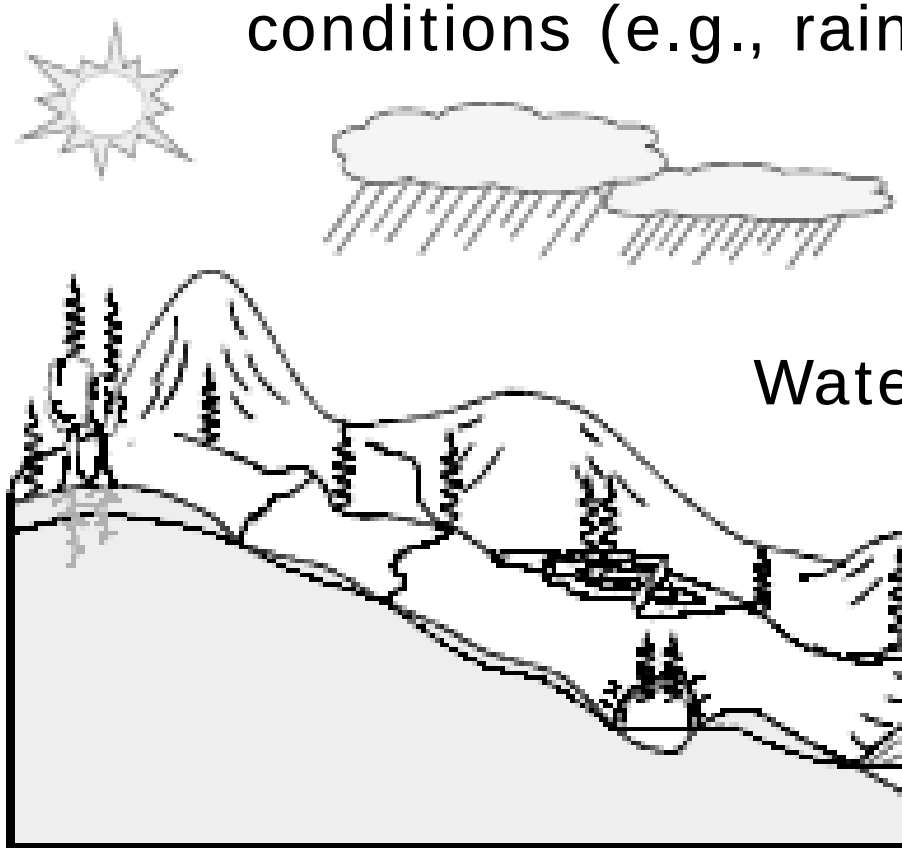
EM 1110-2-1415 Hydrologic frequency analysis





2. HEC-HMS Application

Applied meteorological conditions (e.g., rainfall)



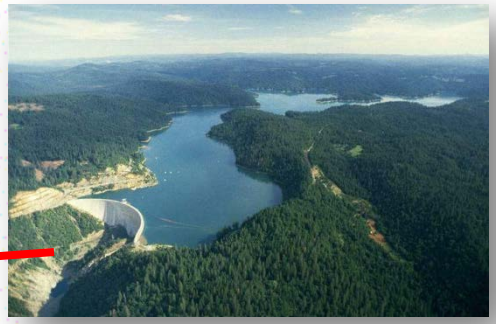
Watershed processes

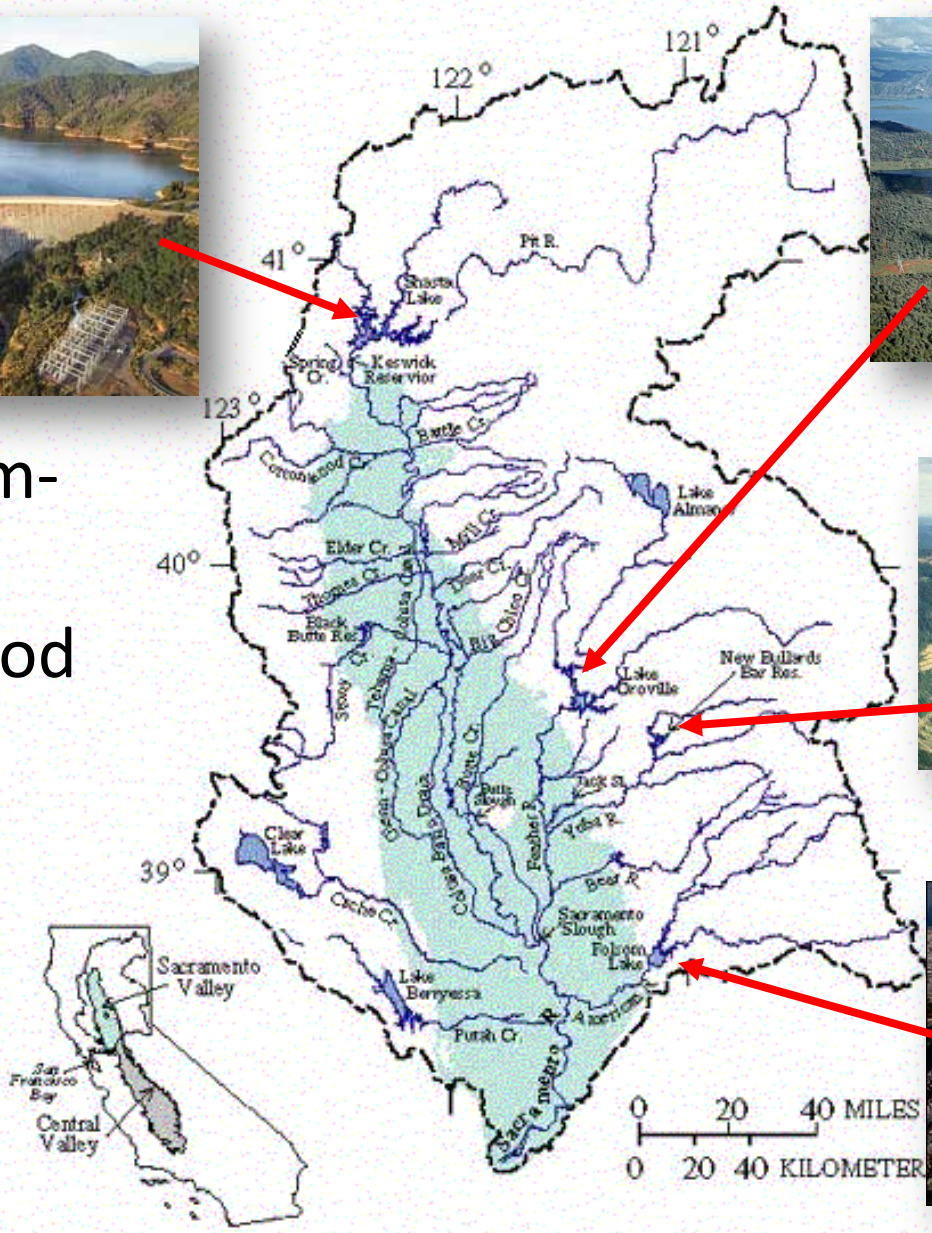
Runoff

2. HEC-HMS Application

- Develop flow-frequency curves in “ungaged” watersheds.
- “Ungaged” watersheds consist of those with:
  - No historical flow data, or
  - Poor historical flow data
- Model sensitivity of selected headwater watersheds to future climate scenarios:
  - “CVSS (Climate Variability Sensitivity Study) Pilot Study.”

3. HEC-ResSim Application

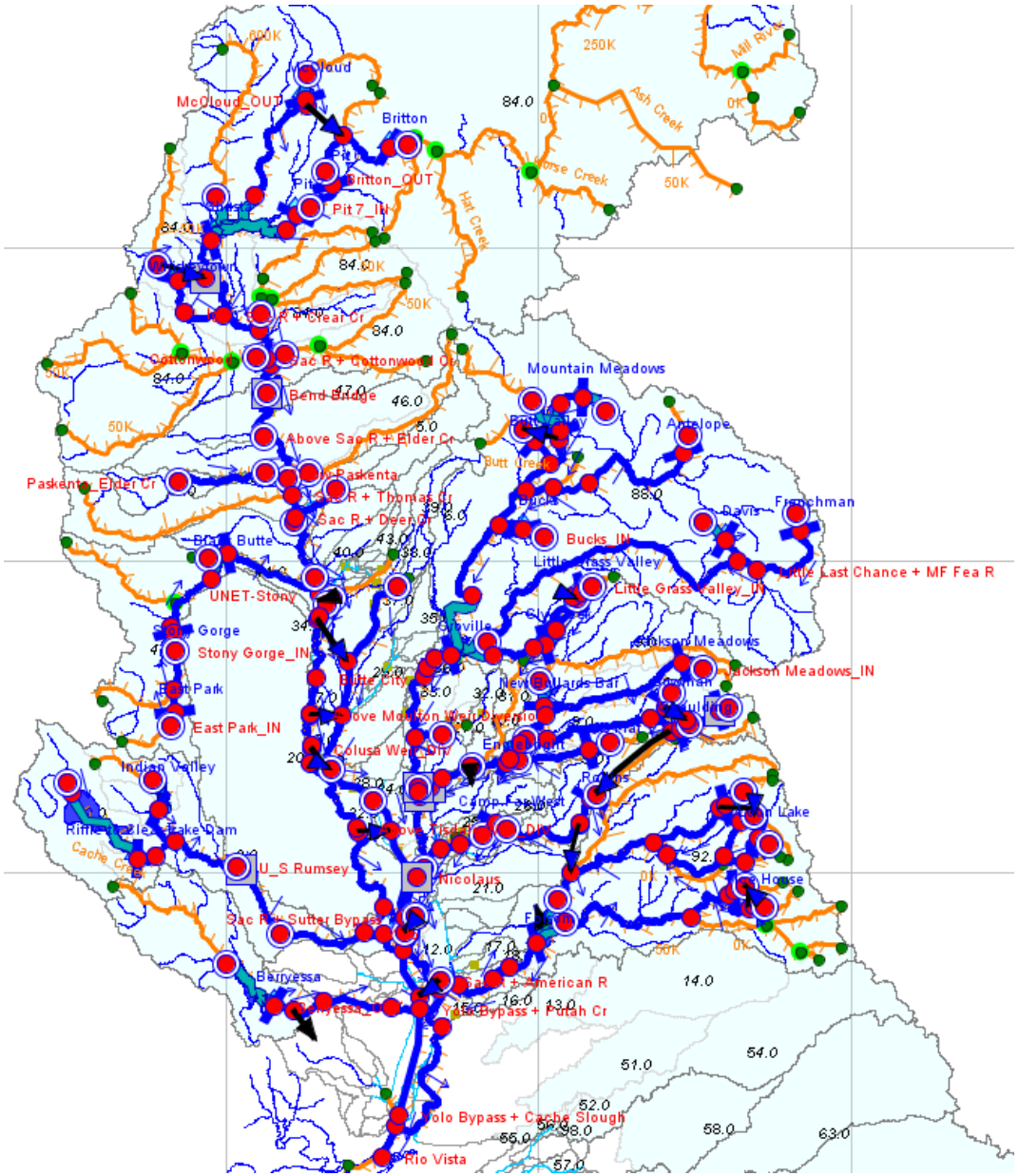




- Large, system-wide model including flood control and headwater reservoirs

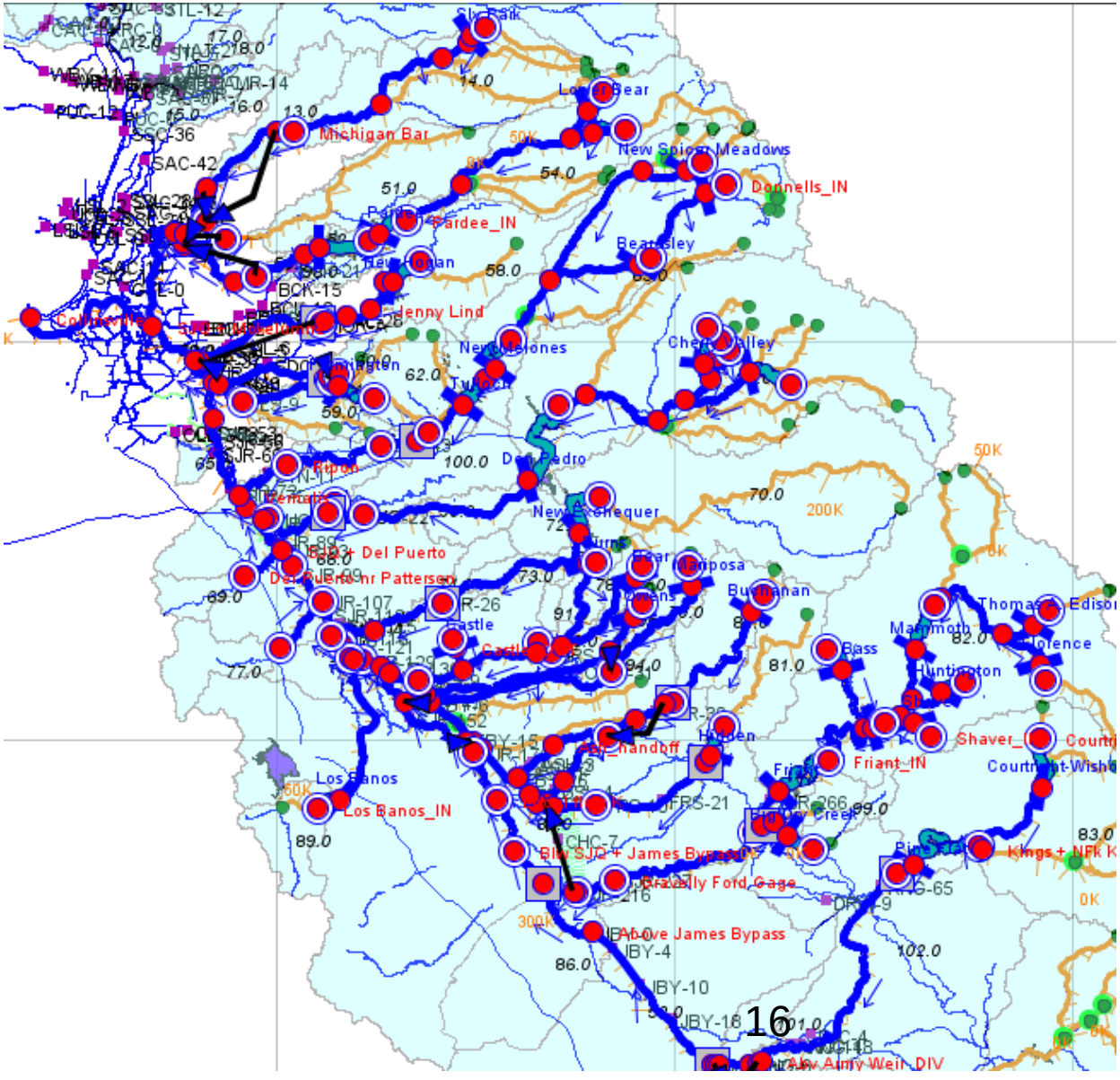
3. HEC-ResSim: Sacramento System

- 37 reservoirs
  (7 flood control,
  30 headwater).
- 17 diversions.
- 209 junctions.
- 65 inflow locations.
- 162 routing reaches.
- Muskingum routing.



3. HEC-ResSim: San Joaquin System

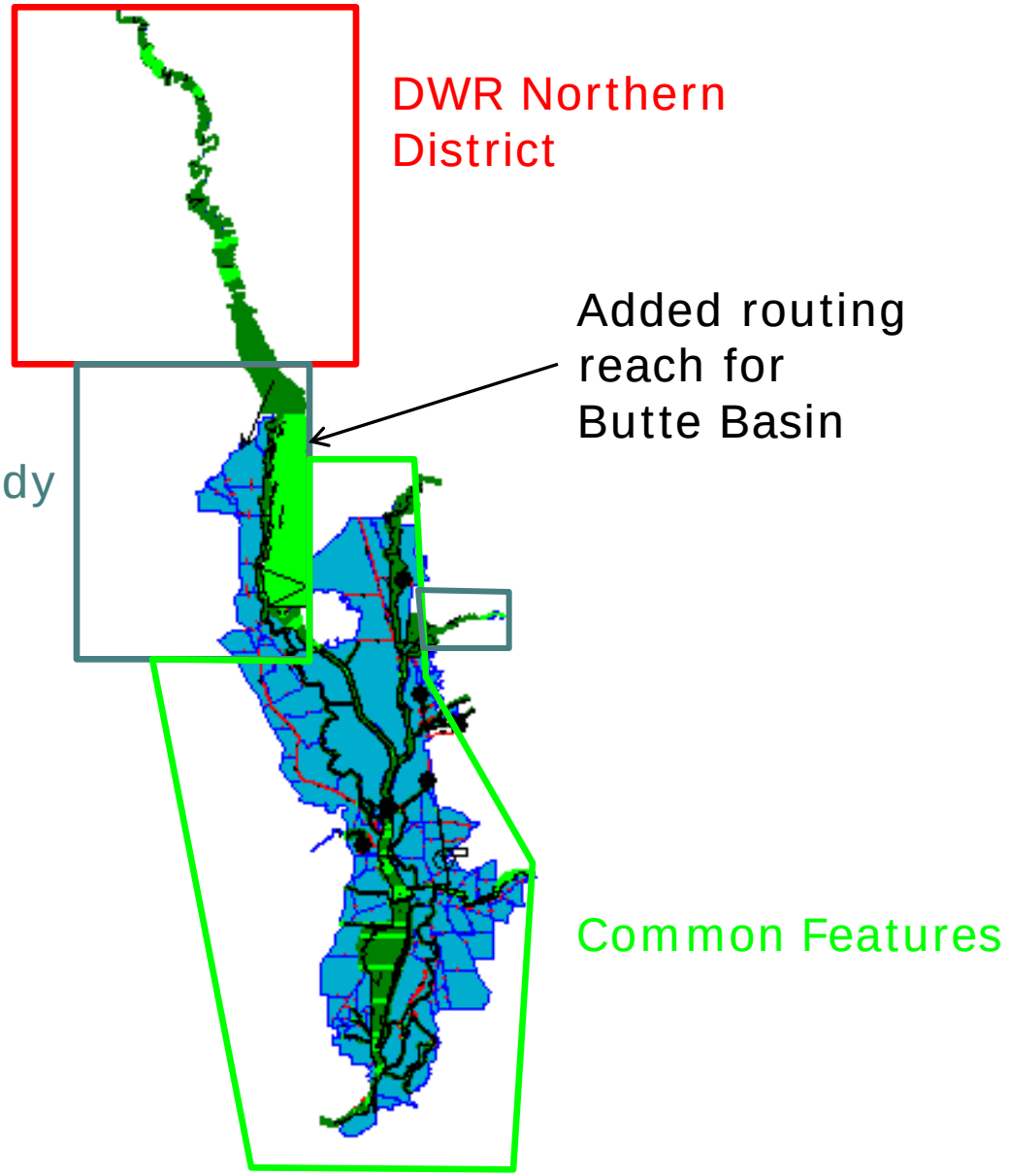
- 36 reservoirs (9 flood control, 27 headwater).
- 17 diversions.
- 205 junctions.
- 74 inflow locations.
- 166 routing reaches.
- Muskingum routing.



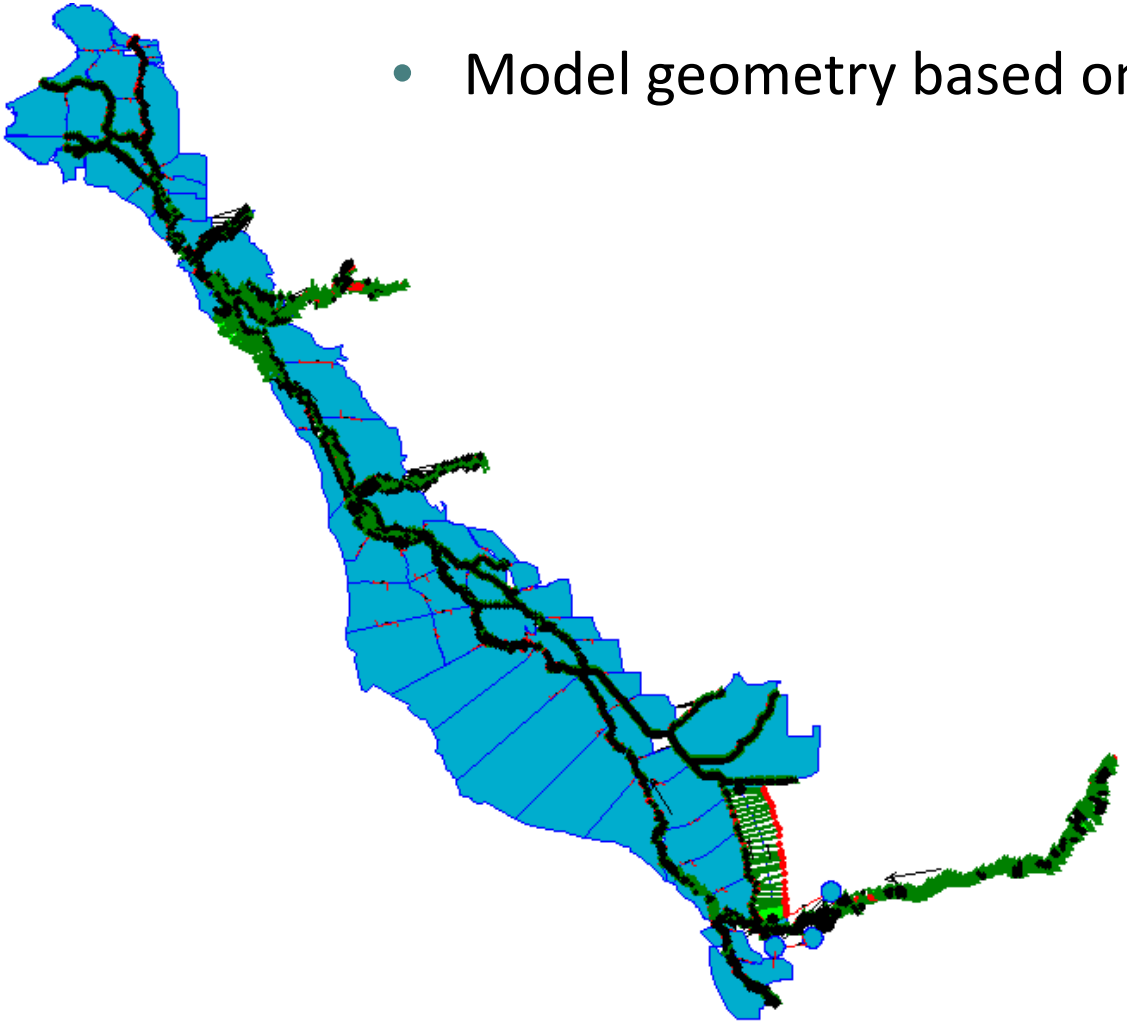
4. HEC-RAS Application

- Route reservoir releases through the leveed system
- Compute water surface elevations at key locations

4. HEC-RAS: Sacramento Model Extents



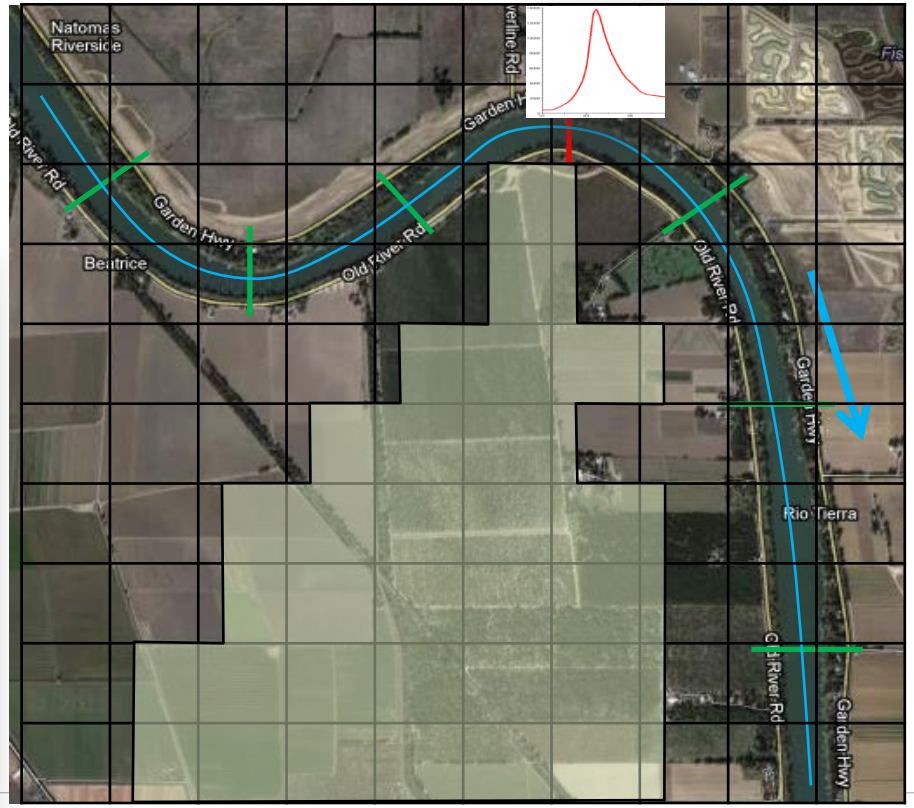
4. HEC-RAS: San Joaquin Model Extents



- Model geometry based on Comp Study

5. Floodplain Models Application

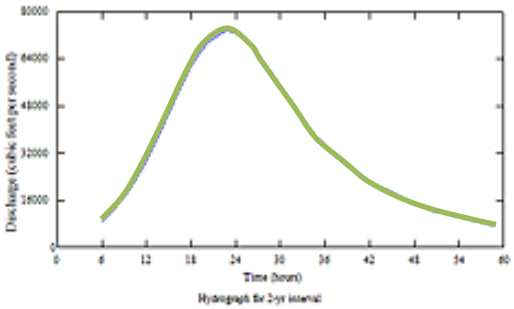
- Compute floodplain elevations when water leaves the channel
- FLO-2D and TUFLOW



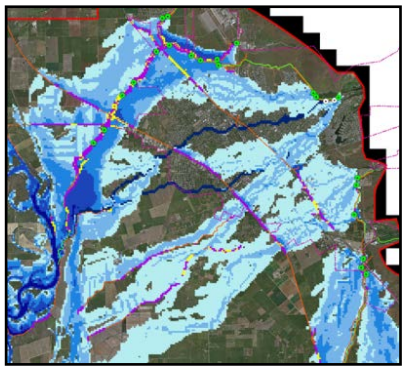
5. General Floodplain Modeling Approach

- Define floodplain geometry and features.
- Simulate levee breach hydrograph in riverine model. Extract breach hydrograph, put in floodplain model
- Route flow through floodplain, compute floodplain depths and velocities.
- Extract floodplain water surface elevations.

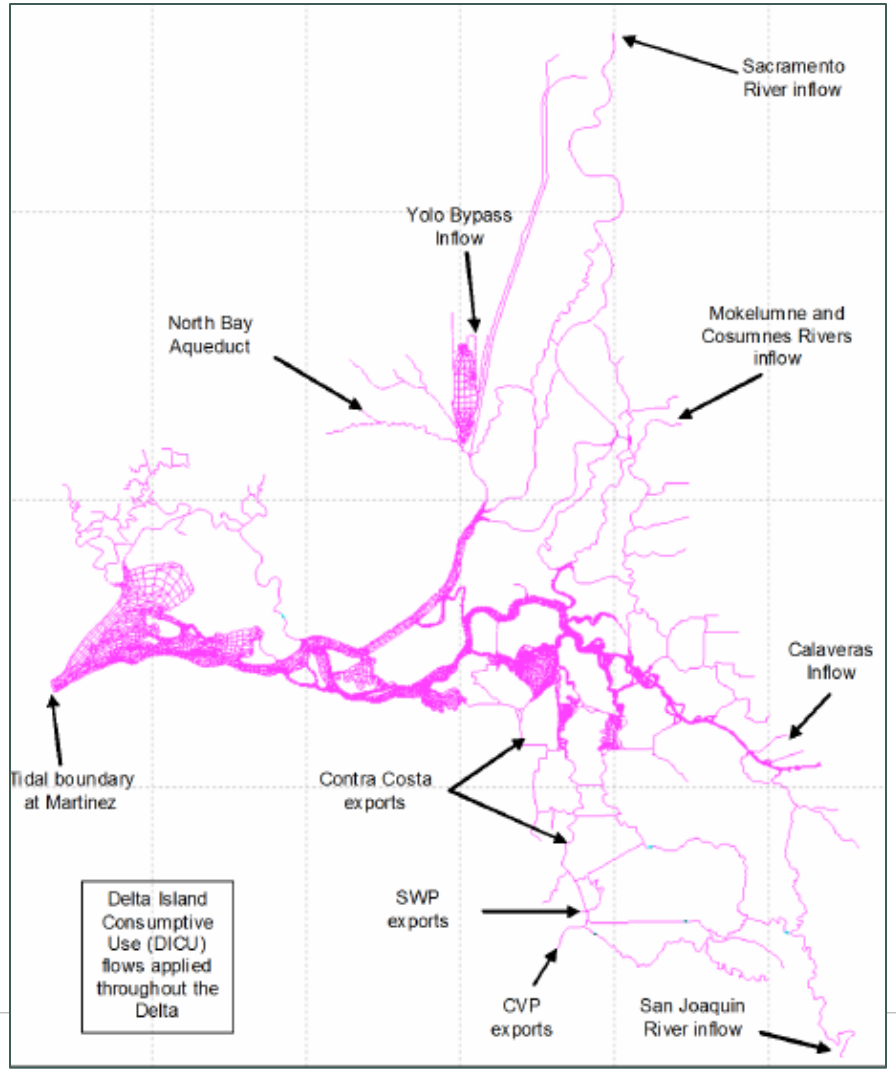
HEC-RAS



FLO-2D/TUFLOW

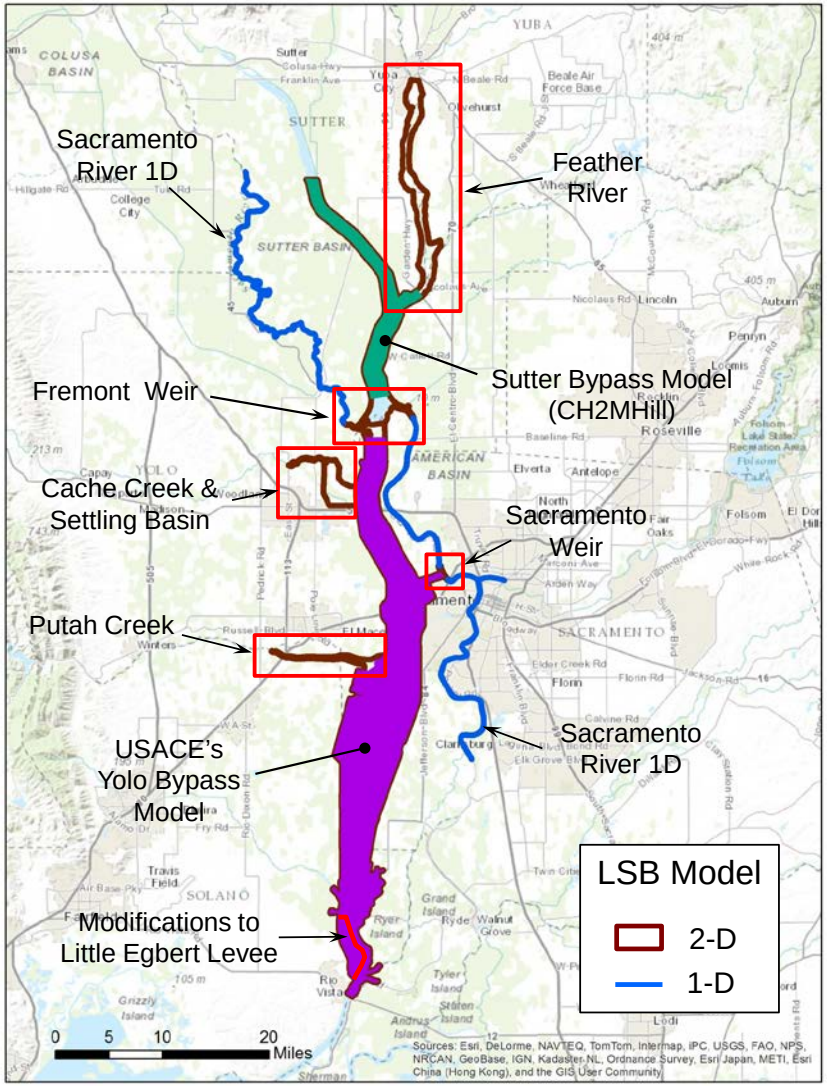


6. RMA2 Bay Delta Model



- Application:
  - Boundary Conditions
  - Sea Level Rise Scenarios

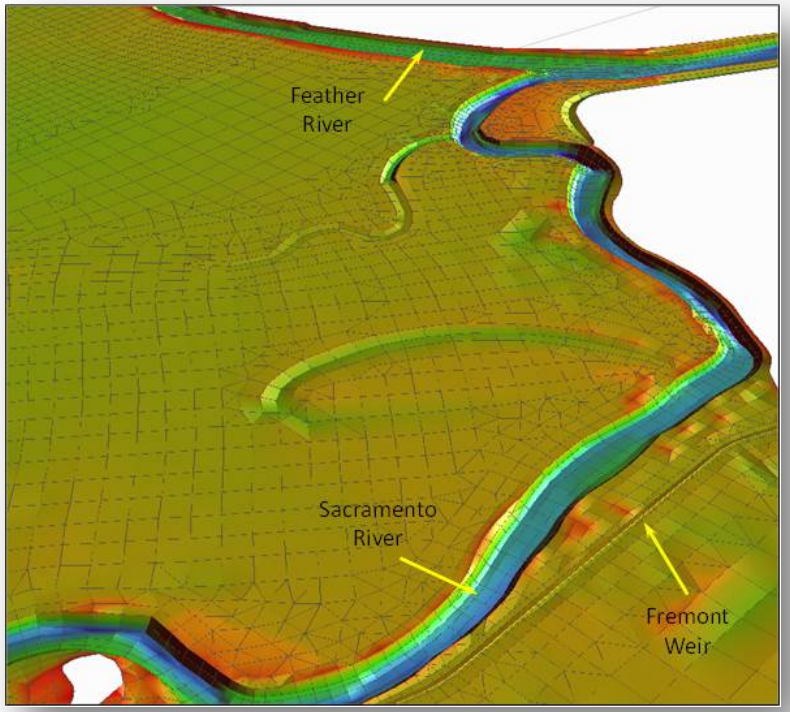
6. RMA2 Lower Sacramento Bypass Model



- Build off of Existing RMA2 Models:
  - USACE Yolo Bypass Model
  - Sutter Bypass Model
- New 2-D Development:
  - Feather River
  - Fremont Weir, Sac Weir
  - Cache Creek and Putah Creek (Backwater)
- 1-D Channel Elements for Sacramento River

6. RMA2 Lower Sacramento Bypass Model: Approach

- Incorporate existing RMA2 models
- Add new 2D grids and 1D channels using CVFED LiDAR and bathymetry
- Friction values based on aerial photography
- Boundary conditions- will use RAS model DSS files
- Model calibration- Jan 2006 event
- Model validation- Jan 1997 event



Summary of H&H Products and Tools

- CVHS and CVFED have provided a range of datasets, hydrologic and hydraulic models.
- Tools are generalized, flexible, standard of practice, and widely available.
- Tools are independent of study assumptions (fully configurable models).
- Tools will be used to evaluate and compare BWFS refined system configurations.
- Tools and information are well-documented and reviewed.
- Tools and models are available from DWR upon request.

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Questions?